

Toyota brake install

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Braking is a complex issue that is dependant on a LARGE number of variables including hydraulics, tires, weight distribution, friction material, and brake construction to name a few. The following modification should ONLY be performed by qualified mechanics as one part of an entire system upgrade. Failure to properly modify braking components will result in a poorly balanced braking system that can reduce the braking distance or make the car hazardous during panic braking. Failure to properly configure your braking system may result in personal injury or death.

TR6 Brake Modification Contributors:

The brake modifications outlined here are a result of observations that certain brake components, intended for other vehicle applications, could be installed on a TR6. The credit goes to the following individuals where were observant enough to discover these improvements:

- John Lye - Toyota 4 piston calipers with stock rotors,
- J.K. Jackson - Morgan rear cylinders.
- Hugh Barber - Toyota 4 piston calipers with vented Toyota Cressida rotors

TR6 Stock Brake Summary:

Front Brakes:

Two types of front calipers were used in the TR6, both have a piston diameter of 54mm.

- lining area: 20.7 in² (133.6 cm²)
- swept area: 233.0 in² (1500 cm²)

Rear Brakes:

Two sizes of rear cylinders were used in the TR6, 0.7 inch bore fitted to US models up to 1976, and 0.75 inch bore fitted to very late US models. The increase in the bore resulted in increased braking force at the rear wheels by 14.7%. It is very interesting to note that the rear brakes were updated while the front remained untouched.

- lining area: 60.5 in² (390 cm²),
- swept area: 99 in² (639 cm²),

Brake Servo:

- servo action: 2.2:1.

TR6 Weight Summary:

TR6 dry weights

year	weight lb	weight kg
1969-1970	2317	1053
1971-1974	2277	1035
1975-1976	2334	1061

Unlike a lot of vehicles the TR6 remained approximately the same weight throughout the production run. It is doubtful that changes to the master cylinder and rear cylinders were due to a change in vehicle weight.

Dynamic Weight Transfer:

Ideally the vehicle weight should be evenly distributed so that each tire contributes evenly to the braking and cornering forces. Unfortunately this condition only occurs if the forces were acting through the center of mass (center of gravity) of the car. This only occurs when the car is half underground, which is not very realistic.

Since the center of mass is above the road surface any acceleration transfers weight to the opposite set of wheels. Accelerate forward and the weight is transferred to the back, brake and the weight is transferred forward. The amount of the weight transfer is proportional to the height of the center of mass above the roadway and the rate of acceleration.

On any properly designed brake system the limiting factor is the tire-to-road friction, which is proportional to the weight applied to the tire. Dynamic weight transfer during braking causes the front brakes to carry a larger percentage of the total vehicle weight and allows the front brakes to generate higher frictional forces. As a result, the front brakes are typically larger than the rear brakes.

Friction Material:

It is important to ensure that the friction material is the same on all four wheels. The coefficient of friction for different brake compounds may vary widely with temperature. As a result a braking system that is balanced when the brakes are cold can become unbalanced when the brakes are hot. At best the braking may be compromised, at worst you can lose control and kill someone.

Front Brakes

The Toyota calipers have two different size pistons; 1.685 and 1.345 inches diameter. The total piston area for each side of the caliper is 1.16 in², which is effectively the same as the 1.13 in² for the TR6 piston. Braking force is the product of the coefficient of friction of the braking material times the caliper piston force. Since the piston force is proportional to the piston area we can make the following assertion:

Addition of Toyota 4 piston calipers will NOT improve braking distances.

The Toyota calipers may be more fade resistant, however, if all other variables are fixed, the braking distance will remain the same.



This is a photo of Toyota 1979-83 four wheel drive pickup (non-diesel) front caliper installed on a TR6 front axle. Note the hard brake line makes several bends to make it possible to access the caliper bolt without removing the brake line.



This illustrates the stock brake and pad on left and the Toyota on the right. The total lining area for the Toyota is approximately 27.8 in² or 179 cm², a 34% increase over the lining area for the TR6. This increased area combined with the large size of the caliper may help reduce pad and caliper temperatures, and thereby reduce brake fade.

Front Brake Installation summary:

1. Obtain a pair of front calipers from a Toyota 1979-83 four wheel drive pickup (non-diesel). I found that the cost of a rebuilt set of calipers was very reasonable from any of the big name auto parts stores. You will typically find that the core charges exceed the cost of the rebuilt unit! Calipers come either loaded (w/ brake pads) or unloaded (w/o pads).
It is important to match front and back brake composition (see note above)
2. Obtain the correct mounting bolts for the calipers. Toyota mounting bolts are 12 mm. There are two versions of the caliper bolts on the TR6. The early version are 7/16", the later version appear to be 12 mm with a 7/16" thread. The calipers should only be attached using the later (larger) diameter bolts

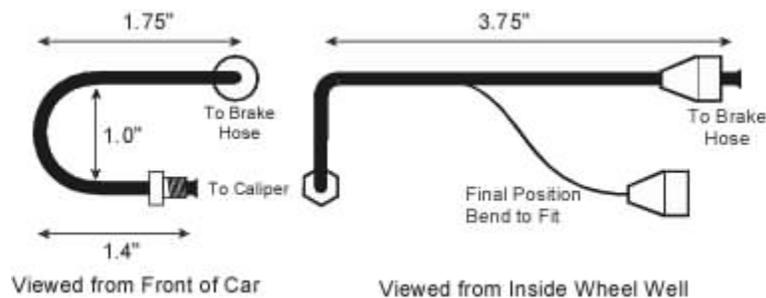
Bolt and bolt hole diameters

- 0.478 Approximate Toyota bolt hole diameter
- 0.470 Approximate Late TR6 caliper bolt diameter (part # 158668 for M16P calipers)
- 0.433 Approximate Early TR6 caliper bolt diameter (do not use!)

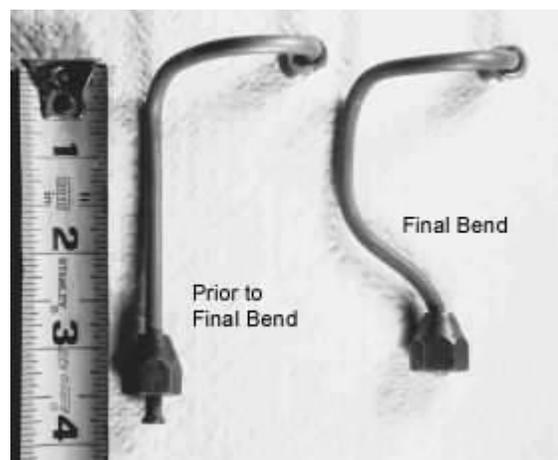
You can see that the late version has about 0.008 tolerance between the bolt and the hole. The

early version has about 0.045 tolerance which is way too much!

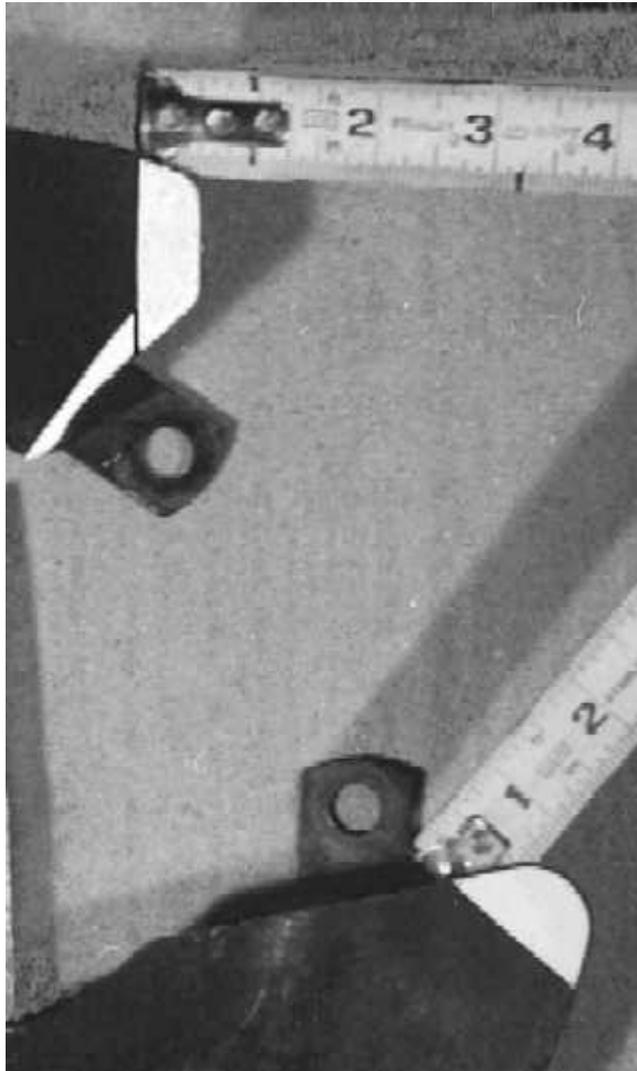
3. Construct a custom hard brake line for the caliper. The inlet for the brake line is different for the two calipers. The Triumph brake inlet points towards the front of the car while the Toyota inlet points toward the center of the car. This minor plumbing problem can be easily fixed using the following transition tube made from standard brake line.
 - o Purchase a section of brake line that fits the metric fitting on the caliper and is the same diameter as the TR6 brake line (typically 1/4 in or 6.25 mm).
 - o Bend the tube as show in the figure below. The bend is to allow access to the caliper bolt.
 - o Next remove the fitting from the existing brake tube and install it on the new line using the appropriate flair tool.
4. Trim the inside dust cover to eliminate interference. Verify the dust cover clears the caliper and trim if required.
5. bleed and test the system in a safe environment where brake failure will not result in personal injury or death.



This schematic illustrates the construction of the hard brake line.



The left tube is prior to the final bend, the right tube is after final bending. The bend allows access to the caliper bolt.



The dust shield must be trimmed to fit. The white region illustrates the cuts that need to be performed. 1/2 inch is trimmed from the top end, 5/8 inch is trimmed from the bottom end. A small sliver is removed next to the upper shield attachment.

The following was submitted to me by Hugh Barber, Hollister, CA, '73 TR6. Thanks Hugh!

Vented Front Brake Installation summary:

1. Obtain vented rotors for a 1986-1988 Toyota Cressida Front Rotor (Sedan Only), Part Numbers - Aimco 3247, Raybestos 96042, Bendix 141410
2. Machine the axle hole to 3.125".
3. Obtain a pair of front calipers from a 1988-mid 1989 Toyota 4-Runner, 4WD, 4Cyl, Part Numbers - Fenco C8554, C8555; Cardone 19-827, 19-826
4. You may also need to purchase a fitting kit (pins, shims, etc) for the calipers and brake pads.
5. The installation is the same as for the non-vented conversion listed above. Sometimes you will need some thin AN washers to shim the caliper (center it on the disk). Some installs need the shims, some don't.

Rear Brakes

Increasing the cylinder size on the rear brakes has been demonstrated to reduce stopping distances by approximately 11%.



The top cylinder with casting number 304170 is a 0.70 inch cylinder for a TR6. The lower cylinder with casting number 64670475 is a 0.875 inch cylinder. for all Morgans from 1959 - 1988 (+4, 4/4, +8) and Sunbeam Alpine series 1 & 2.

Part numbers are:

- Victoria British Ltd.: 7-946,
- Morgan Spares Ltd.: 100-885.

As of 7/2004 the parts supplied by Victoria British are the correct casting but without the Girling part number. This suggests that the part is now being re-manufactured at an affordable cost (about \$30).

The 0.875 inch bore provides 56% more pressure to the shoes than the stock 0.7 inch bore, and 36% more pressure than the very late model 0.75 inch bore.

Rear Brake Installation summary:

1. Obtain a set of 7/8 inch cylinders.
2. remove the old brake cylinder,
3. install the new brake cylinder,
4. bleed and test the system in a safe environment where brake failure will not result in personal injury or death.



This is a photo of an installed stock TR6 cylinder.



This is a photo of an installed Morgan cylinder. The major difference (other than the size of the cylinder) is the retaining tangs that help engage the brake shoe. Note that the tangs do not change the shoe position they simply limit lateral motion.

Additional information on braking systems:

"Brake Handbook" by Fred Puhn, HPBooks 1985, 176 pages. (may be out of print)

"Gimme a Brake" By James Walker Jr. & Tom McCreedy, Grassroots Motorsports,
Feb 2004, vol 21 No 1 page 95-103

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